

The Interpretation of Railway Statistics

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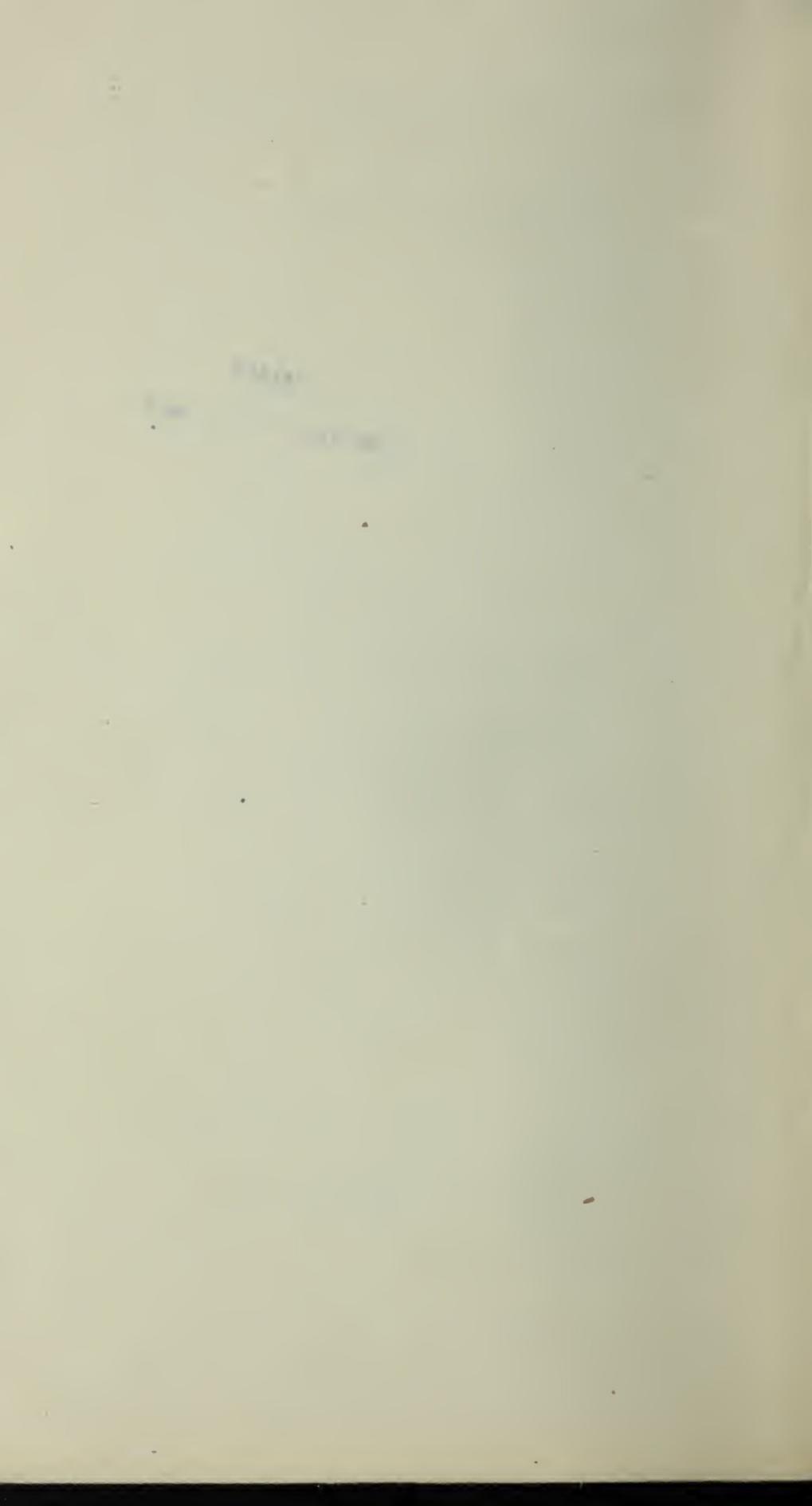
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THE NECESSITY OF CARE IN THE INTERPRETATION OF RAILWAY STATISTICS USED COMPARATIVELY.

The growth in importance of the railway has given to its statistics a publicity and a popularity hardly exceeded by those of any other economic undertaking, and of no country is this truer than the United States. Governmental activity has been a stimulating cause of this abundance of information, but the railways themselves have come to realize that it is good policy to be less reserved in their relations with the public than they have been. Thus, a much larger amount of information has been made accessible than government schedules have called for. The facts available, however, have not always been analyzed with due discrimination. Statistical material is highly dangerous to handle, and even those familiar with its treatment have to act with the utmost wariness and discretion. Its way is not so plain that a wayfaring man, though a fool, need not err therein. Defective comparison, arising out of the omission of vital facts, is common. Certain more or less traditional methods of presentation are followed that assume to carry with them illuminating exposition of vital points of railway development and operation, but are more remarkable for what they fail to tell than for anything they do tell. Brevity is the soul of wit in railway statistics as elsewhere, but it can be pushed to the verge of obscurity and, quite frequently, to the point of insufficiency. Another class of defects in statistical comparison arises from a lack of appreciation of the real significance of the data used: the statistician fails to make himself acquainted with the intrinsic worth of his figures. Nothing can be more inimical to the soundness of statistical logic than a hasty acceptance of material used at its superficial value. It is absolutely essential to scrutinize rigidly methods of compilation. Carelessness or oversight in this connection is responsible for many erroneous analyses and vicious comparisons. The following pages contain a brief review of some of the more important railway statistics in the use of which for comparative purposes the writer has observed more or less serious errors. Some of the points touched upon raise issues of considerable dispute, and, if it seems that such are treated too cavalierly, it must be remembered that this is inevitable in a general treatment of restricted length; at a subsequent time it may be possible to discuss these issues more in detail.

FREIGHT HOUSE TONNAGE COSTS.

A good example of the difficulties besetting the path of the statistician without adequate technical knowledge of his facts is to be found in freight house tonnage costs. Freight house operation seems to be very similar, in a general kind of way, wherever it is carried on, and, therefore, fairly capable of being measured as to its efficiency by the actual per ton costs of

handling. As a matter of fact, however, while a ton of freight is a uniform unit so far as mere weight goes, it is a very variable one, indeed, with respect to its handling. One consignment of freight may require twice as much handling as another of equal weight. Thus a ton of general merchandise will consume more of the working time of weighers, truckers and stowlers than a ton of iron bars. And a ton of merchandise in twenty different packages will be a longer handling proposition than a ton of similar freight in five packages. Freight houses called upon to handle large quantities of mail-order house shipments usually have this factor of increased cost to contend with, no small amount of such business being in very small packages, consigned to an innumerable variety of addresses. Dissimilarity in the nature of the freight handled manifests itself to the highest degree in the railway terminals of districts with different producing interests, but it may be found in terminals located in the same district, and, to the extent that it exists, renders tonnage costs entirely unreliable as a test of relative efficiency. I have heard of this consideration being ignored even by railway officers in comparing the tonnage costs of freight stations at different points on the lines under their jurisdiction. The officers concerned were perhaps relatives of the newly-appointed division superintendent who, being requested by shippers on his division to provide them with double decker cars, objected on the ground of the expense that would be involved in raising the bridges.

Another element with an important influence upon tonnage cost is the size of the freight business handled. The small freight house seems able to give an appreciable lead to its bigger brother in handling costs, this arising largely from the fact that the bigger freight house required for the business of the latter increases the trucking that has to be done. It ought to be possible, however, to offset much, if not all, of this increase by the introduction of mechanical appliances in the larger houses, but, so far, American freight houses are not remarkable for their achievements in this direction. The more important English terminals, it is interesting to note, have made considerable progress in the utilization of hydraulic and electrical power.

Where delivery of freight is undertaken or arranged for by the railways, local conditions may cause, at some stations, an abnormal amount of rehandling, which, of course, leaves its mark upon the tonnage costs. Variations of cost, arising from such cause, do not exist in this country to the extent that they do, for instance, in England. In very rare instances do railways here undertake the delivery of freight. But it is essential to bear in mind this rehandling element of cost when comparing American with English performances or the costs of various English goods depots. At some important points in England the amount of warehousing, as it is termed, is considerably above the normal, an appreciable portion of the

inward freight, instead of being sent out directly by the wagons of the company or of its carting agents, having to be raised by crane to a second, third, or even fourth, story, trucked over a floor often of large area, with the reverse operation to be gone through when the consignee calls for the freight. Sometimes the agent is allowed extra tonnage on this warehousing for the purpose of making costs comparable; thus, for every ton warehoused, a ton and a half, say, would be reckoned in computing the average cost, but this practice is by no means universal.

Tonnage costs as between one terminal and another may be affected by differences in the quality of labor available for freight-house work. Should it happen that the labor environment of two terminals differed very materially, it would be unfair to the local management at the less favorably situated one to accept tonnage costs as indicative of relative efficiency without adjustment being made for this difference. Occasionally very special labor conditions introduce a still further disturbing element. I cannot think of a better illustration than the casual labor so effectively made use of at several of the London goods depots. Where labor of this kind can be procured but a minimum full-time or regular working force needs to be maintained, the casual labor, waiting around the office for a job, being brought in for the busy period at a comparatively low rate of wage per hour. Ordinarily, such labor would be regarded as unreliable and inefficient for the class of work to be done, but in London this does not seem to be the case. In fact, a considerable number of these men become more or less regular "half-timers," and vacancies in the full-time force are filled from their ranks quite frequently. Strange as it may appear it sometimes happens that such promotion is refused, the chosen ones preferring the comparatively go-as-you-please conditions of casual employment to the more rigid requirements of regular work. The result of such labor arrangements is to enable the terminals thus advantageously situated to keep their tonnage costs far below what they would normally be.

Freight-house costs, it is hardly necessary to observe, may be "in" or "out;" that is to say, the costs of working inbound or outbound freight. The two are essentially distinct. Under normal conditions, the cost of working inbound freight should run lower than that of outbound, since the former freight can be unloaded with greater dispatch and less irregularly than is the case with the corresponding operations of loading.

Tonnage costs are commonly relied upon as a fair basis for the comparison of efficiency in the *same* freight-house from period to period, and, as a rule, justifiably so. But, even in this case, the value of the comparison depends upon the absence of change in the general nature of the tonnage handled as well as on other conditions. But traffic conditions alone being taken into account, it is quite possible that a

change in these might increase tonnage costs, say, from 35c. to 37c. a ton, in spite of a real improvement in the working efficiency of the house during the period of comparison.

From what has been said it appears very evident that as a comparative measure of relative efficiency of management the tonnage cost of handling may prove to be a very misleading guide, especially when applied to different terminals, but, at times, even when applied to the same terminal.

YARD CAR COSTS.

Yard car costs also require considerable care in their use. As a test of relative skill of management, they fail because of the differences in labor quality, in nature of work to be done, in the physical condition of the yard, in climatic and other conditions. But they may be, and frequently are, rendered entirely useless for statistical purposes because of the lack of a uniform system in compiling them. Thus, some terminals base their yard costs per car upon the number of cars received and forwarded in trains and received from and delivered to connecting lines. In other cases, not only these car movements are included, but also many of the internal movements, such as cars to and from transfer tracks, cars to and from team tracks, and so on. This difficulty as to what properly constitutes a car movement could be overcome by agreement, but at the present time it still presents a serious obstacle to the successful comparison of yard costs as they are actually furnished by different terminals. In every case, it is necessary to go behind the figures given and to analyze their method of compilation.

PASSENGER AND TON-MILEAGE COSTS.

Passenger and ton-mileage costs have been made much use of by practical men and by theorists, but, frequently, with a careless disregard of the limits of their usefulness. More than one writer has been content to assume the propriety of measuring the general operating efficiency of one railway system against that of another by means of the costs of operation per passenger or per ton per mile. Such a comparison is too unreliable to be depended upon as a guide to relative efficiency. It takes for granted that labor, physical, traffic and other conditions are fairly similar, though, in fact, they are frequently extremely dissimilar. To say that one road operates its freight traffic at eight-tenths of a cent per ton-mile and another road at six-tenths of a cent is to throw absolutely no light upon the skill with which the freight traffic of the respective roads is worked. The road with the higher ton-mile cost may be the one most efficiently operated. The only real value of such traffic mileage costs is in keeping track of the movement of operating costs on the same railway, or, preferably, on the individual divisions comprising a railway. I say preferably, as regards the latter, because the general average for the railway as a whole may have remained unchanged over the period of investigation

and yet the real operating conditions may have materially altered, progression on some divisions being counterbalanced by retrogression on other divisions. Even within the limits of a single railway it may be decidedly unfair to measure the operating results of one division against those of another—conditions must be substantially similar before cost results can be accepted as the basis of such a comparison.

The value of ton-mile costs has been emphasized by some because of a belief that they afford a scientific basis for the establishment of reasonable rates. Yet, it is not possible to allocate, other than by arbitrary pro-rates, more than, at the most, about 75 per cent. of even the transportation and maintenance costs to the respective freight and passenger services. And since, as a matter of practical necessity, a railway must pay interest on funded debt, interest on current liabilities, rents for leased lines, taxes, and, for future protection, permanent improvement expenditures charged to income, there still remains nearly 30 per cent. of the total expenditures, essential to the working of the system, which again can be allocated only on a more or less arbitrary pro-rating basis. Thus, close upon half of the annual costs of maintaining a railway organization and securing its operation are, in the present state of our knowledge of railway costs, incapable of being accurately divided. The actual cost might vary materially from the pro-rated cost, and, to the extent of this variation, the reliability of the latter as a criterion would be impaired.

But even if it were practicable to allocate to the freight service as a whole its proper proportion of costs, it would still be a far cry to the distribution of these costs between the multitude of commodities transported by the railway under very varying conditions of speed, equipment facilities, terminal handling and so forth. There are some happily-dispositioned writers and regulative bodies who see all these difficulties vanishing into thin air when resort is had to some magical pro-rating basis as train mileage or gross ton-mileage, or the like. These engineers of philosophy are so much in advance of many of us poor mortals that they have no trouble in determining the roadway maintenance expense due to a 50-mile an hour 500-ton through express passenger train as compared with that due to a 12-mile an hour 2,500-ton freight train, stopping, maybe, at almost every siding. Their attitude is picturesque, but unconvincing.

It should be said further that if an allocation of costs to each unit of freight could be satisfactorily made, the problem of reasonableness would still remain unsettled. The theory of reasonable rate determination with reference to traffic mileage costs means, I take it, the fixing of a rate at a figure allowing a reasonable rate of profit above cost of operation; but, as a practical proposition, how is the latter to be determined? It should certainly be reasonably related to the

risks and difficulties of the business, but who is to fix the specific nature of that relation? Are the risks of railway business equal to, less than, or greater than, those of banking, insurance, steel manufacture? If not identical, what percentage of variation in profits will represent the variation in risk? Again, absolutely uniform efficiency of management cannot be expected, and uniformity of working environment is, of course, impossible. Hence, one series of railway operations under control of railway company X will be handled much more economically than a corresponding series controlled by railway company Y, resulting in a lower cost per unit of traffic. Is X to be allowed to charge rates similar to Y, and, if so, is the extra large profit it secures as a result of its greater efficiency a reasonable rate of profit? On the other hand, if its rates are adjusted so as to reduce its rate of profit to the same level as that of Y, will there not result territorial rate discrimination quite as clear-cut as anything that occurs under the present commercial system of rate making?

TRAIN AND ENGINE-MILE AVERAGES.

Other interesting operating statistics are train and engine-mile averages, which, in their general form, have less utility than some would ascribe to them. A passenger train-mile covers everything from the more or less dilapidated crawling local on branch lines to 60 miles an hour luxuriously appointed expresses on the main line, from a train of an engine and one car to one with a dozen or more cars. Similarly, the freight train mile coerces into statistical uniformity the humblest way freight with, perhaps, a total weight of a couple of hundred tons behind the tender to the 100-car, 3,000-ton train; it connects the slow "dead" freight train with the high-speed "manifest" train: coal train, live stock, merchandise train—all are indiscriminately mingled in the average. An arithmetical average is obtained, it is true, but one of treacherous utility, unless environed by a galaxy of interpreting, modifying and saving clauses, only to be used by the initiated, and even then with the greatest circumspection.

It is still customary, on the part of some transportation students, to depend upon engine mileage as a reliable basis upon which to establish comparative efficiency statistics of an important brand of railway operation. The value of such statistics depends very largely upon the way in which they are put together. But general averages of engine-mile costs can hardly be regarded, under any conditions, as affording the means of drawing conclusions of any practical worth. The engine-mile, in its general form, is itself variable. Its elements may be freight or passenger or switching engine, high-speed Atlantic or low-speed consolidations, with tractive powers of infinite variety. Obviously, when such engine mileage is used as a measure of costs, it fails lamentably to serve any useful purpose. To do this it must be limited to engines

of the same general class, and even then its definiteness is not altogether satisfactory. Clearly, a compound unit of performance which allows for the influences of physical conditions, such as gradient and curvature, and also for speed, is the only sort of unit really suitable even in a restricted analysis of engine mileage costs. Uniform units of work done need to be established and engine costs related to these; this the engine-mile average fails to do.

FREIGHT CAR TON MILEAGE.

Freight car efficiency is a matter of great railway interest and its proper measurement seems to be logically based upon the performance of the average car in loaded car miles. The calculation of this would ordinarily be a very simple process, namely, the division of the total ton mileage by the number of cars employed. Unfortunately for the student of railway reports, it is not obtainable so easily as one would suppose from the foregoing. In the first place, the freight cars reported as owned, both in the statistics furnished in the annual reports of the Interstate Commerce Commission and in very many railway reports, are those owned on the last day of the fiscal year. It is obvious that the loaded car miles are made by the actual cars in operation, some of which have been in service throughout the year, others for less periods varying from several months to but a few days. Evidently, the equivalent number of cars owned throughout the year is required as the divisor, otherwise the quotient will be more or less inaccurate as a test of efficiency. In the second place, the ton mileage reported is the result of work done both by home and foreign cars. Cases have been known in which the cars upon the lines of a railway have exceeded by as much as one hundred per cent. the number owned by it. Under such conditions, even if the equivalent number of cars owned throughout the year were available, the quotient of total ton mileage divided by the same would be very far from representing the exact work of the cars. Of course, in dealing with statistics of the United States as a whole, this possible source of error disappears except in so far as car relations with Canada and Mexico affect the situation, and any disturbance of results from such would be so small as to be negligible. In the third place, reported ton mileage is made up of tonnage hauled by the railway both in its own cars and in privately owned cars. Here again it is apparent that the car ton mileage obtained in the usual fashion is in error. The private cars working the ton mileage need to be included, or better, for purposes of the comparison of efficiency of the freight car operation of different roads, the ton mileage of private cars excluded. The latter is preferable because of the special conditions surrounding certain classes of private car movement, ensuring frequently a superior performance to that of the railway owned car, and, further, because of the differences, as between railways, in the extent of this private car traffic.

But supposing that all these difficulties in the determination of freight car performance are satisfactorily met, the greatest caution is still required in interpreting the results. It is quite conceivable that a lower ton mileage average may represent as great or greater operating efficiency on the part of the railway concerned as the higher one of another road. This arises out of the varying influence on mileage of different species of traffic. The larger the proportion of local freight traffic, the lower will tend to be the mileage made, but the reduced ton mileage average by no means infers less efficiency. Again, the existence of an unusually large percentage of colliery traffic will ordinarily exercise a depressive influence upon the ton mileage, on account of mine delays and unloading time allowances. Demurrage regulations are also a factor not to be overlooked in deducing results from ton mileage performances of railways situated in different territories. If the legal loading or unloading free time is 48 hours in the territory of one road and 96 hours in the territory of another, mileage movement in the latter case is restricted. The restriction is not effective to the extent of the difference in legal time, it may be noted, since there would be in both territories a large number of shippers who would not make use of the legal maximum.

THE OPERATING RATIO.

The operating ratio is generally accepted as a statistic of great value. Yet in the usual form of the percentage of total annual operating expenditure to total annual operating revenue, its value is liable to exaggeration. The same operating ratio may conceal any number of changes in efficiency of performance from year to year. Thus, in a certain year, extravagant operation during the season of light traffic may be counterbalanced by an abnormal increase of business during the period of heavy traffic, with the result that the operating ratio stands at the same level as, or even lower than, in the previous year when, say, greater uniform efficiency of operation was obtained throughout the year. The general operating ratio may frequently fail to indicate movements in maintenance of roadway, maintenance of equipment, traffic, conducting transportation, and general administration, in which considerable variations may occur and yet leave no record in the general ratio. The mere statement that the operating ratio is this and that in years of comparison is meaningless from the point of view of operating efficiency until most careful scrutiny is made of its component factors. An increase in it may cover greater efficiency, a decrease relatively greater inefficiency, and a stationary position either one or the other.

Error can easily be made in comparing operating ratios of different systems by reason of opposed financial policies in the roads compared. For example, the ratios are not comparable in the case of two systems, one of which charges as much of permanent improvement expenditure as possible to repairs account and the other as little as possible.

PASSENGER ACCIDENT AVERAGES.

Passenger train accident figures are of all railway statistics the ones which are most profusely presented to and most eagerly devoured by the public. It goes without saying that the presentation of numbers of killed and injured without reference either to the conditions out of which the accidents arose or to the relation of these numbers to the traffic is a very partial and defective, therefore improper, method of comparing safety in travel on different systems. Nor are such averages as number killed and number injured per so many passenger journeys of appreciable value in endeavoring to measure the relative frequency of accident.

It is necessary, in the first place, to segregate accidents arising out of passenger train movement and beyond the control of the passenger, from the rest, and, in the second place, to average these accidents upon the passenger train mileage, so many accidents per one million train miles, and, associated with this average, should be the average number killed and average number injured per one million train miles. The latter figures emphasize the waste of human life and efficiency, but to my mind the former averages are the more valuable. The number killed and injured in a collision or derailment is almost a pure matter of chance, influenced by car structure, by presence of inflammable oils, live coals, etc., by distribution of passengers in the cars, and by other circumstances. An accident that, by all theory, ought to have caused the most serious disaster may be trifling in its effect; an accident that normally would have produced a few injuries may, unexpectedly, result in lamentable loss of life. So that really, relative efficiency, in the matter of avoiding accidents in passenger traffic, would be shown best, not by reference to persons killed and injured, but by the number of train accidents per million passenger train miles, and such figures would form a desirable addition to every report of railway accidents. Railways have a natural aversion to display their weaknesses in the form of train accidents, but it would exert a beneficial influence upon them if they were required half year by half year to publish in the leading daily papers a full statement on oath showing the relationship of their accident roll during the period to the amount of traffic they handle. At the same time it would be unfair to the railways to pass on without saying that several roads have been and are devoting great attention to the removal of the causes of accidents. Surprise checking, public investigations, and so on, are some of the methods that promise satisfactorily.

MILEAGE STATISTICS.

Little need be said here about mileage statistics. It is obviously inaccurate to compare the extent of railway systems by route, or geographical, miles. Such a comparison ignores the capacities of the systems compared, as represented by addi-

tional tracks and varying yard facilities. It is like comparing two factories on the basis of the number of machines employed, without reference to the capacity of the same. Of late years this has been rectified in some private and official statistics by showing, in addition to route mileage, single track mileage, and, in some cases, mileage of yards and sidings. Even when this information is given, further analysis is required if one is to gain a useful idea as to the real meaning of the mileage to the community. When comparing the mileage of railways or railway systems, the student needs always to ask himself the question as to the extent to which effective distribution of mileage has been attained, and effectiveness in this case should refer to the general economic interests of the country, for, after all, such interests in the long run underlie private progress and success. The distribution of the mileage is an important consideration, since, in two regions of equal area and equal railway mileage, the mileage may be well spread in one and very badly spread in the other. It is to the ultimate economic interests of any state or country that its railway mileage should be located so as to give reasonable, though not necessarily uniformly equal, accessibility to all districts. Over-concentration of mileage in one part, a not uncommon phenomenon, is frequently accompanied by lack of facilities in other parts. Again, an area intermediate between two other areas may have a fairly considerable railway mileage much more calculated to serve the interests of the other areas than those of its own. Mileage per unit of area or per unit of population is a useful figure, but incomplete. Equality in these respects may hide very real differences of utility and an area with an inferior showing may really be better served.

TRAFFIC MEASUREMENT.

Limits of space forbid much attention in this article to the statistics of traffic measurement, though the subject is one worthy of detailed discussion. It is generally understood that, for purposes of comparison of freight business, ton-mileage is a more adequate basis than actual tonnage. Yet even ton-mileage is unsatisfactory; its general nature necessarily deprives it of efficiency as a measure where conditions are different, as is commonly the case. The tonnage movement measured may be largely one of minerals "foreign received" and "foreign delivered," or it may be largely one of merchandise locally collected and distributed. In amount of work involved, in value of service to the railway, the traffic of one road would be poles apart from that of the other, but no indication whatever of these differences would find expression in the general ton-mileage figures. In every case of summarized statistical presentation of freight traffic conditions it should be made an invariable rule to show grouped commodity ton-mileage; in most instances the requirements of general comparison would be met by a classification into forest products, mine products,

agricultural products, manufactures, merchandise and miscellaneous. From statistics of this kind one is able to form a fairly intelligible idea of the traffic of roads compared and their relative importance in this respect, which is more than can be said of the lumped ton-mileage figures. A further division might be made into *local*, *through-originating*, *through-terminal* and *through-transfer*, understanding by these terms the ton-mileage of freight forwarded from and delivered to stations on company's system (*local*), forwarded from local stations to "foreign" points (*through-originating*), received at local stations from "foreign" points (*through-terminal*), and received from "foreign" stations for delivery to "foreign" stations (*through-transfer*). This would complicate somewhat any general tabulation of statistics, but not seriously, when the information deducible from the addition is taken into account. Briefness of exposition and economy of space are idle virtues if they are secured at the expense of intelligibility.

CAPITALIZATION STATISTICS.

Capitalization per mile is a statistic which incompetent hands are capable of badly mis-using. Intrinsically the figure is worthless, for comparison useless, unless qualified by a whole host of explanatory clauses. Yet it is frequently used in comparing costs of different systems. The practice is faulty because (1) the comparison is made on geographical mileage whereas the expenditure has been made on track mileage, (2) the manipulation of capital in the form of nominal additions has varied considerably from system to system so that the ratios of real costs are very different from those of nominal costs, (3) the existing extent of capital has been influenced to no small degree by differences in policy as to the handling of betterment expenditures. In any case, since conditions of legal procedure, land acquisition, labor supply and so forth, vary most widely in railway building, it is hard to see how much wiser one is for knowing that Railway X cost \$70,000 a mile and Railway Y \$250,000, even when adjustment has been made for artificial differences in capitalization. Certainly, without a very detailed knowledge of the underlying conditions, it would be hazardous to assert that the former road was economically built and the latter extravagantly. The costliness of a machine is relative to the work it does, and hence, of the two, the \$70,000 road may happen to be the extravagantly built one.

Capitalization statistics evidence great variations in capital per mile of line, and this fact, correlated, as it has been, with spectacular feats of financial legerdemain on the part of certain railways, has wrought a conviction in the minds of many that overcapitalization is a common condition of American railways, influencing unfavorably the level of rates. Now it is unquestionable that considerable nominal additions have been made to railway capital, but against such increases need

be set off the also considerable portions of revenue that have been expended in permanent improvement, as well as those decreases in capital that have occasionally occurred in transfer of ownership. It is impossible to determine the relative size of these items, and he is a man of easy conviction who is prepared to argue that, for the railways of the United States as a whole, the former is materially greater than the latter. And if it is, the difference must be very much less than most people credit. The previous statement infers that the proper measure of railway capitalization is actual original investment in the property plus the cost of improvements whether paid for out of capital or out of revenue. If railway building were to be started all over again, the restriction of capitalization within these limits would be justifiable, theoretically, at any rate. It is to the interest of the investing public, and of the community at large, that the real profit capacity of every railway property should be apparent on the face of its balance sheet and income account; only when capitalization is identical with actual investment, is it practicable to keep track of the real profitability of the undertaking. It would surely seem that actual investment in the building and improvement of a railway is the logical basis of capitalization, though it may be a very untenable one from the standpoint of business men and their traditional methods. But, comes the objection, is it not proper, even theoretically, to allow X or Y to increase the capitalization of a railway he purchases up to the limit of the price actually paid? Does not this price represent to him a real investment? Plausible though this seems, I can hardly admit that it is theoretically justifiable. What X or Y pays to secure the profits to which each certificate of the capitalization entitles him represents his valuation of the property; thereby he decides with what rate of profit he will be satisfied. The money he pays goes, not into the railway, but into the pocket of its former owners. There is no valid reason why his valuation and what he purchases, namely, the investment of a million dollars, or whatever it may be, in the production of a certain utility, should be equalized. In fact, logically they cannot be. The investment for the purpose of producing the utility, and it is immaterial whether some part of this investment was judiciously made or not, is one thing, and his investment for the purpose of securing the profits arising out of that utility is another. As a matter of fact, the purposes underlying increase of capitalization, following acquisition of a property, are frequently those relating to speculative trading or to the concealment of rate of profit. This does not deny the justification, either at the time of a purchase, or at any other time, of an increase in capitalization equal to those permanent improvement expenditures out of the revenue of the property not previously taken into capital account, or, of course, of an increase in capitalization for the purpose of

securing funds which are intended to be, and actually are, sunk in the business. I fully realize that the application of the theory now stated would have retarded the promotion and construction of certain railways, but the history of railway enterprise in this country, especially for the couple of decades or so following the Civil War, leads one to believe that this retardation might have had advantages of its own, and that there would have been less economic loss from foolish location and unduly speculative building.

A business undertaking is sometimes capitalized at an amount over and above that necessary to carry on the business, only a part of the amount called for by each share being actually subscribed, this arrangement having advantages in enabling further capital (within the limit of the share liability) to be obtained with certainty, promptness, and frequently with economy. In such cases, the real capital is the subscribed capital, and the law should require every official statement of capitalization of such a company, and every stock exchange quotation, to be accompanied by figures showing the subscribed value of each stock certificate.

Sufficient has been said to indicate the rashness of a sweeping charge of overcapitalization, since it is clear that the only real and satisfactory test of capitalization cannot be applied. This difficulty has induced financial writers to suggest the application of cost of reproduction or of market valuation of securities as suitable criteria. The latter is but a function of income-earning power, representing an averaging down of profits, and bears no relation to the investment. Capitalization on this basis serves but to hide the real profitability of the investment. And, anyhow, the market prices of securities bought and sold on the exchange form an unreliable guide, because these are the prices usually of but limited amounts, and it by no means follows that an offering of the whole issue at one time would secure similar prices. Cost of reduplication is obtaining more favor than market valuation, but, obviously, as costs and conditions of construction are constantly changing, the cost of reduplication may be far removed from the actual costs, and hence this fails as an accurate criterion. Yet in the case of the majority of American railways, a physical valuation of the existing property would probably represent a reasonably fair maximum capitalization, and capitalization much in excess of this, though not necessarily fictitious, must be looked upon with suspicion. If physical valuation is to be accepted as a satisfactory test of capitalization, the charge of general overcapitalization must forthwith disappear, as it may safely be said to be impossible to reproduce the railways of the United States for the amount per mile represented by their capitalization.

The effect of overcapitalization upon rates falls too much outside the scope of this article to justify more than a brief reference. It is difficult to imagine that, under the competi-



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tive conditions so characteristic of a large part of the railway business of the United States, degree of capitalization can definitely influence transportation rates. The capital invested in railways is largely sunk once and for all. Track, locomotives, cars and appliances will deteriorate, even if not used. Hence, any rate that returns, in the estimation of the railway manager, somewhat more than sufficient to defray wear and tear due to the traffic and cost of transportation will be better than no traffic. This is, under ordinary conditions, the nether limit of rates, a limit to which they rarely descend, but the existence of which, nevertheless, is powerful in influencing the actual level at which they settle. Such favorable conditions for the exercise of competition prevent the railway manager from basing his rates upon the capitalization. Thus it happens that, in the case of a group of important western roads, the one with more than three times the capitalization of any of its rivals is forced, by the exigencies of competition, to give even lower rates than the others. Where a condition of monopoly exists, it is possible that overcapitalization may have a general effect upon rates, if the rates, before the excess of capital is superimposed, are such that an appreciable increase in them would neither lessen present traffic nor prevent the development of future traffic to any appreciable extent. If the railway, under such monopolistic conditions, is already exacting the return which gives it the maximum net profit, then an increase in rates would be inconceivable, as it would slow down the traffic and represent a voluntary reduction of profit to a point below the maximum. The conditions under which cases of capitalization tend to affect the general level of rates are much more likely to occur in local than in through traffic, but even local rates fail to show many instances of increase that can be definitely ascribed to manipulation of capitalization.

The foregoing survey of some of the more important railway statistics has been by no means exhaustive, but enough has been said, it is hoped, to emphasize the limitation attaching to them, especially as usually presented, and the necessity of a careful and intelligent interpretation. Neither railway officials nor writers employing such statistics have always exercised good judgment in this respect. Too frequently may they be found resorting to reasoning which suggests, as a well-known statistician remarked some years ago, "a man trying to lift himself over a fence by his boot straps." It is, indeed, extremely easy in statistical elaboration to pass from one assumption to another until out of a mass of figures certain results are obtained which are accepted as precise and accurate without recognition of their hypothetical basis. Only by extreme vigilance can errors of this kind be avoided. In so far as the previous discussion may act as a reminder of this "proneness to error" in statistical reasoning, it will have served its purpose.